State of Michigan's Environment 2008:
First Triennial Report
December 2008
Part III: Emerging Contaminants of Concern

Michigan Department of Environmental Quality
Michigan Department of Natural Resources

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Prepared by KGH Environmental PLC

State of Michigan's Environment

Legislative Charge (1999 Public Act 195):

- Prepare a report that assesses the status of and trends related to the overall state of the natural environment in Michigan.
- The report shall be based upon environmental indicators identified by the departments of environmental quality and natural resources (DEQ and DNR) and upon data obtained through sound scientific methodologies and processes.

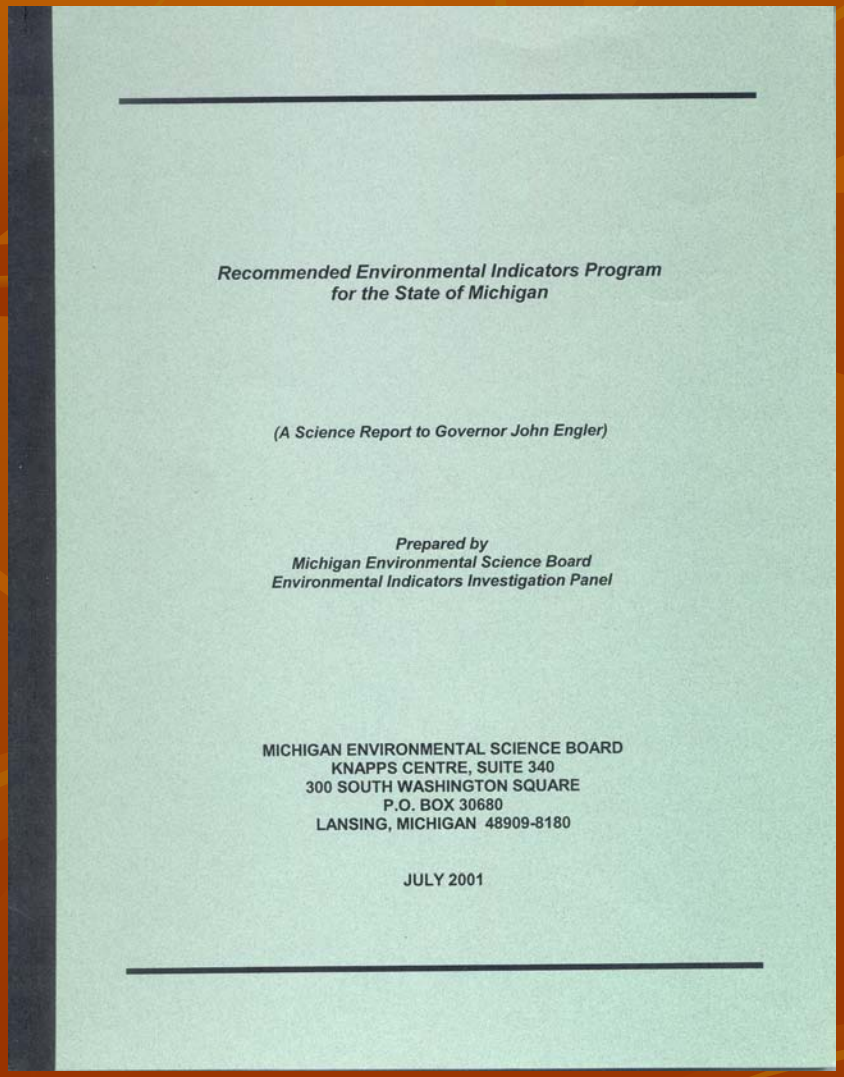
State of Michigan's Environment

Governor's January 28, 2000 Charge to the Michigan Environmental Science Board (MESB):

Review the list of DEQ and DNR proposed environmental indicators and evaluate each of the proposed indicators based on the following criteria:

- **Scientific basis for the use of the indicator as a measure of the quality of the environment** (i.e., does the proposed indicator describe a measure of the natural environment); and
- **Utility of the indicator** (i.e., what would it mean in terms of the quality of the environment if there is a change in the value of the indicator from one reporting period to the next).

MESB July 2001 Report Recommendations



Recommended Environmental Indicators Program for the State of Michigan

(A Science Report to Governor John Engler)

Prepared by
Michigan Environmental Science Board
Environmental Indicators Investigation Panel

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JULY 2001

Of the indicators proposed by the DNR and DEQ, the MESB recommended that 21 be included in the biennial report on the state's environment.

The MESB also recommended that the state begin to develop a monitoring protocol referred to as Master Stations in order to begin to systematically and consistently collect information on the state's environment.

Working Definitions

- **Environmental Indicators** are scientific, broadly based measures designed to detect and track changes in the quality of the state's ambient environment from one reporting period to the next.
- **Programmatic Measurements** are measures that, while in and of themselves may ultimately detect a change in the overall quality of the environment, are designed more to assess how well a given regulatory program is functioning to correct or control more short-term or localized environmental problems.
- **Emerging Contaminants of Concern** are newly recognized environmental chemicals and/or materials that are characterized by a perceived, potential, or real threat to human health or the environment or a lack of published health standards.

Biennial Report Measurements

- **Environmental Measures** [22]*
  - Ecological Indicators (11)
  - Physical/Chemical Indicators (11)
- **Programmatic Measures** [20]
  - Air Measures (4)
  - Water Measures (7)
  - Land Measures (9)
- **Emergent Contaminants** [14]**

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* Fulfills the requirements of 1999 Public Act 195 and 2005 Public Act 313

** Fourteen contaminants of concern are identified

State of Michigan's Environment 2008: First Triennial Report

Submitted to the Governor and Legislature December 2008

In addition to being widely distributed, the report was made available to every high school science teacher in the state to be used as teaching resource.

State of Michigan's Environment 2008: First Triennial Report

Part III
Emerging Contaminants of Concern

Emerging Contaminants of Concern

Recent awareness that many of the products and chemicals designed to offer improvements in industry, agriculture, medical treatment, and day-to-day life are causing contamination of air, water, and land resources.

The USEPA defines an emerging contaminant as *a chemical or material that is characterized by a perceived, potential, or real threat to human health or the environment or a lack of published health standards*. A contaminant also may be "emerging" because a new source or a new pathway to humans has been discovered or a new detection method or treatment technology has been developed.

Emerging Contaminants of Concern

Fourteen Emerging Contaminants of Concern are discussed in the report:

1. **Polybrominated diphenyl ethers**
2. **Pharmaceuticals and Personal Care Products**
3. **Perfluorooctane sulfonate**
4. **Polychlorinated naphthalenes**
5. **Tetrahydrofurans**
6. **Alkylphenol ethoxylates**
7. **1,2,3-Trichloropropane**
8. **N-Nitrosodimethylamine**
9. **Tungsten**
10. **Perchlorate**
11. **1,4-Dioxane**
12. **Manganese**
13. **Nanomaterials**
14. **Ethylenediaminetetraacetic acid**

Emerging Contaminants of Concern

Polybrominated Diphenyl Ethers

- Family of chemicals that are added to plastics to make them difficult to burn. The production of PBDEs began in the 1970s.
- Types of concern: Penta-, Octa-, and Deca-PBDEs
- BDEs enter the air, water and soil during their manufacture and disposal.
- PBDEs have been found in mollusk, fish, birds and humans.

Emerging Contaminants of Concern
Polybrominated Diphenyl Ethers

- In 2005, legislation was passed in Michigan that placed restrictions on Penta-BDE and Octa-BDE due to their persistence, bioaccumulation, and toxicity. The legislation prohibited the manufacture, processing, and distribution of products containing more than one tenth of one percent of Penta-BDE or Octa-BDE beginning June 1, 2006.
- In 2007, the MDEQ report was updated with attention focused on Deca-BDE. The report entitled, *Polybrominated Diphenyl Ethers: A Scientific Review with Risk Characterization and Recommendations*, currently is undergoing final MDEQ review.

Emerging Contaminants of Concern

Pharmaceuticals and Personal Care Products

- Pharmaceuticals and Personal Care Products (PPCPs) constitute a wide variety of bioactive agents including: antibiotics, steroids, environmental estrogens, endocrine-active chemicals, and hormone-related toxicants.
- Primary Sources of PPCPs are treated and untreated human sewage, runoff from confined feeding lots, and facilities caring for medicated pets.
- Pharmaceuticals typically occur as a continual source of trace environmental pollutants to surface and ground water.

Emerging Contaminants of Concern
Pharmaceuticals and Personal Care Products

- Concern that PPCPs (rather than better known contaminants) may be responsible for observed and suspected endocrine disruption issues and increasing susceptibility to bacterial infections.
- Need to scientifically document extent and magnitude of the problem.
- Need to evaluate current ways to remove or treat PPCPs in waste streams.

Emerging Contaminants of Concern
Perfluorinated Compounds (PFCs)

- PFCs are found in found in hundreds of commercial products because of their ability to impart stain, water, and flame resistance.
- PFCs have been found in a wide variety of fish and wildlife at low levels.
- Research is currently underway to better characterize PFCs.

Emerging Contaminants of Concern
Polychlorinated Naphthalenes (PCNs)

- PCNs are a group of compounds used as engine oil additives, insulation, water repellents and some wood, paper, and fabric preservatives.
- PCNs have been found in sediment, ambient air, wildlife, and human tissues.
- Research is currently underway to better characterize PCNs.

Emerging Contaminants of Concern
Tetrahydrofurans and Alkylphenol Ethoxylates

- Tetrahydrofurans are substances that have been increasing since the 1980s. They are used in the production of elastomers, fibers, cements and coatings.
- Alkylphenol Ethoxylates are used in various industrial processes and degrade into more toxic chemical in water. These breakdown compounds have been found in the upper and lower segments of the Detroit and the Rough Rivers.
- Research on both contaminants is ongoing.

Emerging Contaminants of Concern
1,2,3-Trichloropropane (TCP)

- TCP is a man-made chlorinated hydrocarbon chemical. It has been used as an industrial solvent, a cleaning and degreasing agent, an extractive agent, and in the production of pesticides.

- Animal studies suggest that long-term exposure to TCP may result in adverse effects to the kidneys. TCP is recognized by California as a human carcinogen.

Emerging Contaminants of Concern
N-Nitrosodimethylamine (NDMA)

- NDMA currently is not produced in pure form or commercially used, except for research purposes. It was used in the production of liquid rocket fuel, antioxidants, and softeners for copolymers. NDMA may be produced as a chemical by-product from manufacturing. Industrial sources of these by-products may include tanneries, pesticide and rocket fuel manufacturing plants, and rubber and tire manufacturers.

- The USEPA has listed NDMA as a priority pollutant, but no federal standards have been established for drinking water.

Emerging Contaminants of Concern
Tungsten

- Tungsten alloy alternatives have replaced lead shot ammunition for migratory waterfowl hunting. Approximately 50,000 people hunted waterfowl in Michigan during the 2005 and 2006 waterfowl seasons. It is unclear what volume of tungsten-based shot may have been introduced into the environment.
- There are very limited data on adverse effects of tungsten in humans. Tungsten has not been classified for potential carcinogenic effects by any United States or international agency.

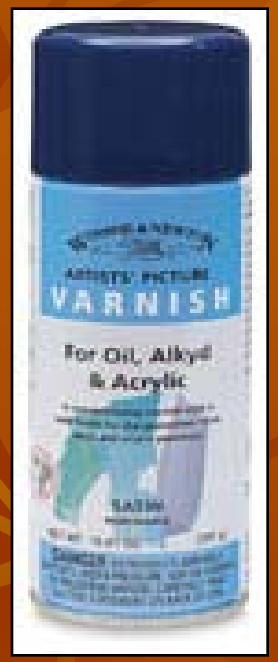
Emerging Contaminants of Concern
Perchlorate

- Perchlorate is a persistent contaminant of concern. While naturally occurring, perchlorate salts are commonly manufactured for use as an oxidizer in solid propellants, munitions, fireworks, airbag initiators for automobiles, matches, and signal flares.

- The primary route of human exposure to perchlorate is ingestion of contaminated food and drinking water. Once ingested, perchlorate competes with iodine for uptake into the thyroid gland. As a result, excessive exposure can potentially alter thyroid homeostasis The USEPA has not established a federal drinking water standard for perchlorate.

Emerging Contaminants of Concern
1,4-Dioxane

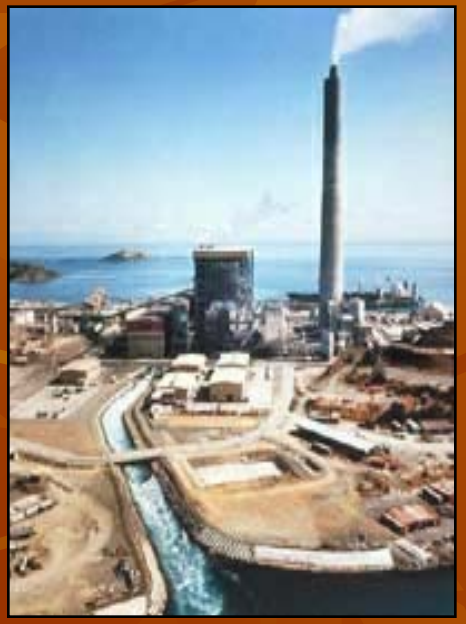
- 1,4-Dioxane is a colorless, volatile liquid and is completely miscible in water and organic solvents. It is used as a solvent such products as cleaning and detergent preparations, lacquers, varnishes, cosmetics, and adhesives. It also has been used as an extraction medium of animal and vegetable oils and as a laboratory reagent.
- Lifetime exposure to 1,4-Dioxane in the drinking water of rats and mice resulted in liver cancer; the rats also developed cancer inside the nose. 1,4-Dioxane is regulated as a human carcinogen in Michigan.



Emerging Contaminants of Concern

Manganese

- Manganese is a naturally occurring element. It is used as an additive in the steel manufacturing process and is emitted from sources burning fossil fuels such as coal-fired electric utilities.
- Manganese is neurotoxic at high concentrations, affecting fine motor skills such as eye-hand coordination. Studies in experimental animals have observed reproductive effects and a potential to accumulate in the brain.



Emerging Contaminants of Concern
Nanomaterials

- Nanomaterials are elements such as carbon, zinc, gold, and iron scaled down to 100 nanometers or less into various structures (rods, tubes, spheres) which impart useful properties. These materials are already in use in literally hundreds of consumer products including tennis rackets, clothing, electronics, sunscreen, and cosmetics.
- Toxicity information on nanomaterials is quite limited.

Emerging Contaminants of Concern
Ethylenediaminetetraacetic Acid (EDTA)

- EDTA binds with metal ions to form metal-EDTA complexes. The metals that usually are most strongly bound to EDTA are iron, copper, zinc, calcium, and sodium.
- EDTA is utilized in various applications including sanitizing solutions, colognes, cosmetics, food additives, and in medical treatment for heavy metal poisoning. Its ability to form complexes with metals poses a concern for groundwater.

State of Michigan's Environment 2008: First Triennial Report

Summary for Parts I - III

- In general, the available data clearly demonstrate that Michigan's air and water have significantly improved during the last 40 to 50 years.

- With the marked reduction of contaminants, the air has become clearer and cleaner, many of Michigan's lakes, rivers and streams have seen improvement, and many previously at risk animal species have been observed to again increase in both population and viability.

State of Michigan's Environment 2008: First Triennial Report

Summary for Parts I - III (continued)

- While, clearly, many improvements in air and water can be seen, other problems have since surfaced. Many of these "new" concerns, however, really are not new. Most of them, such as non-point source pollution, urban sprawl, loss of habitat, exotic species, were around in the 1960s also. The difference is that impacts of most of these were overshadowed by the more dramatic impacts of the other contaminants. These are the areas where the state now needs to focus its attention.

- In addition to the above, we also can point to several issues that are just now beginning to be seen as problems and where little information exists regarding adverse impacts. These emerging contaminants of concern also will need the state's attention.

Additional Information Sources:

Michigan Department of Environmental Quality

www.michigan.gov/deq

Michigan Department of Natural Resources

www.michigan.gov/dnr

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